USDA

United States Department of Agriculture

Forest Service Research and Development Performance and Accountability Report

Fiscal Year 2015

Forest Service FS-1076 August 2016

The Research and Development (R&D) mission of the Forest Service, an agency of the U.S. Department of Agriculture (USDA), is to develop and deliver knowledge and innovative technology to improve the health and use of the Nation's forests and grasslands—both public and private.

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Cover photo: Understanding factors that provide quality experiences for tribal members who gather culturally important forest products (such as beargrass in this photo) is the focus of ongoing research led by the Pacific Northwest Research Station in cooperation with many partners. Photo courtesy of B. Gervais, Forest Service intern.

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ABOUT THIS REPORT

The Government Performance and Results Act of 1993 requires all Federal agencies to engage in a strategic planning process that aligns resources with results and improves the accountability of all Government activities to the American people.

This process focuses on results and includes the development and implementation of a 5-year strategic plan. Annual reporting identifies specific, measurable targets for performance at the beginning of each fiscal year and a year-end assessment of the success of these endeavors.

The *Forest Service Research and Development Performance and Accountability Report, Fiscal Year 2015* is the year-end progress report of the USDA Forest Service, Research and Development (R&D) Deputy Area. The data that Forest Service R&D used to measure performance are collected using a standardized methodology that conforms to generally recognized principles for reporting.

This report describes the Forest Service R&D organization, explains how it has applied the public's investments, and provides an accounting of budgets and accomplishments. It aims to help policymakers make informed decisions and presents an overview for all Americans interested in the workings of their Government and R&D's ability to manage for results in delivering its information, technology, and applications.


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CONTENTS

MESSAGE FROM THE ACTING DEPUTY CHIEF OF RESEARCH AND DEVELOPMENT

Dr. Carlos Rodriguez-Franco
Acting Deputy Chief of Research and Development

I am pleased to present the *Forest Service Research and Development Performance and Accountability Report, Fiscal Year 2015*. This report presents key budget and financial information to Congress and other external interested parties for purposes of transparency and accountability, and it serves as a year-end progress report to inform the American people of the return on their investments. The report also identifies areas of anticipated change and future focus.

Sound scientific information is needed for land management decisions that address problems from invasive pests, pollution, fire, water shortages, and population pressures that are facing our forests, grasslands, and urban environments. Research and Development (R&D) in the Forest Service, an agency of the U.S. Department of Agriculture, supports the core mission of the Forest Service by providing solutions to complex problems, high-quality scientific information, and science-based options and tools. Forest Service R&D helps land managers restore and maintain healthy forests and grasslands for community protection, as well as provide multiple environmental and social benefits, such as clean air and clean and abundant water; a great array of recreational opportunities; and a wide range of ecosystem services important for the American people. Forest Service R&D contributes to the responsible management of the Nation's natural resources by creating innovative ways to protect, use, enhance, and sustain these forests for the benefit of all.

Sustainable management of the Nation's forests and rangelands is at the forefront of contemporary policy and land management decisions. To effectively inform policy and guide actions, science must address complex ecological and human social processes, climate change and variability, large-scale natural disturbances, urbanization, bioenergy, globalization, and the rapid growth of knowledge. Forest Service R&D is leading in providing cutting-edge science in an environment of constrained future budgets, increasing accountability, ever-changing public values, and evolving research partnerships.

Forest Service R&D supports the Forest Service mission of *sustaining the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations* through dedicated scientists

and technical staffs. R&D is recognized worldwide for its contributions to basic scientific knowledge and cutting-edge applications. Forest Service R&D also offers long-term, established research projects; a committed land base (including experimental forests and rangelands, watersheds, grasslands, demonstration areas, and research natural areas); ties to land managers; regional, national, and global perspectives; and a public service focus on questions of public significance.

I hope you read this report and visit our Web page, where you will find 45,000 publications with detailed information about our scientific findings.

Sincerely,

Dr. Carlos Rodriguez-Franco
Acting Deputy Chief of Research and Development

THE R&D MISSION

The Research and Development (R&D) Deputy Area has a vision and mission that each flow directly from U.S. Department of Agriculture (USDA) and Forest Service strategic goals, objectives, and values.

The mission of Forest Service R&D is to conduct innovative and seminal research that provides sound science, innovative technologies, and practical applications to improve the health and productivity of our Nation's forests and grasslands, inform natural resources policy and land management decisions, and anticipate emerging natural resource issues.

Forest Service R&D values a dynamic and diverse workforce and is recognized as one of the premier natural resources research organizations in the world. We strive to be highly respected and influential advocates for innovative, highly valued science programs that inform sound natural resource management decisions, strengthen policymaking, and enable the Forest Service to fulfill its motto of "Caring for the land and serving people."

ORGANIZATIONAL STRUCTURE

The R&D mission area has been a vital part of the Forest Service since the agency's inception in 1905. The organization consists of five research stations; the Forest Products Laboratory (FPL) in Madison, WI; the International Institute of Tropical Forestry (IITF) in Puerto Rico; and 81 experimental forests and rangelands. Forest Service R&D interacts with the National Forest System (NFS) through the national forests in nine regions and with the State and Private Forest (S&PF) Deputy Area throughout the United States. Forest Service R&D is also allied with agencies in the USDA Research, Education, and Economics mission area, that includes the Agricultural Research Service (ARS), National Institute of Food and Agriculture, National Agricultural Statistics Service, and ARS's National Agricultural Library. Forest Service R&D also partners with other Federal agencies, nongovernmental organizations, universities, and the private sector.

WASHINGTON OFFICE STAFFS

In FY 2014, WO R&D successfully realigned itself to more effectively maximize performance and efficiency, to produce tangible results that add public value, and to respond to an increased demand for scientific expertise and anticipated shifts in budget, workload, and capacity. Five staff groups were structured to ensure scientific and programmatic consistency and synergy between the research stations and national headquarters, provide science-based leadership in agency policy decisionmaking, and provide strategic leadership and evaluation across broad program areas. This structure also helps to ensure timely and effective coordination and cooperation with other deputy areas within the Forest Service; with other USDA and Federal agencies, the Office of Management and Budget, and Congress; and with key non-Federal clients and stakeholders. By disseminating relevant research information and new technologies, this structure also helps headquarters make science-based policy and management decisions; ensures the consistent application of standards and procedures; and builds support for continued investments in research programs, facilities, and employees.

The **Sustainable Forest Management Research** (SFMR) staff has leadership responsibility in the R&D mission area for three broad lines of inquiry: (1) advancing understanding about the interactions between stressors, threats, and disturbances and the health, productivity, and sustainability of forests and rangelands; (2) assessing changes and risks to the biological diversity, health, productivity, and sustainability of forest- and rangeland-dependent species; and (3) creating restoration strategies and management options for public and private forests, rangelands, and agroforestry lands. The prime objective for the SFMR staff members across these three lines of inquiry is to build—through syntheses and advocacy of field scientists' findings—a solid scientific foundation for natural resource management and policymaking at multiple spatial scales in boreal, temperate, and tropical forest ecosystems.

The **Inventory, Monitoring, & Assessment Research** (IMAR) staff has leadership responsibility in the R&D mission area for four broad lines of inquiry: (1) leading the Forest Inventory & Analysis (FIA) program and delivering it through five station units and partners inside and outside the Forest Service; (2) assessing cutting-edge developments in monitoring, remote sensing, and geospatial analysis and helping set priorities for further work within the R&D mission area to capitalize on them; (3) conducting assessments of renewable resource conditions—including analyses of current conditions, recent trends, and projected future conditions—and setting priorities for techniques research on assessment and projection methodologies; and (4) expanding and accelerating the use of decision-support systems and tools for land management planning. The prime objective for IMAR staff across these four lines of inquiry is to build through synthesis and integration of field scientists' findings a solid scientific foundation for natural resource management and policymaking at multiple spatial scales in boreal, temperate, and tropical forest ecosystems. The IMAR staff also has leadership responsibility for the R&D mission area for setting policies for quality assurance and quality control (QA/QC) strategies and tactics, including statistical and peer reviews of R&D study plans, manuscripts, and reports, and conducting oversight to validate ongoing station activities in these areas and assure national consistency in QA/QC strategies and tactics.

The **Landscape Restoration and Ecosystem Services Research** (LRESR) staff has leadership responsibility in the R&D mission area for five broad lines of inquiry: (1) providing renewable natural resource managers and policymakers with economic evaluations and decision tools for management and policy options that promote healthy, resilient watershed conditions and wildlife and fish habitats; (2) designing new approaches to "green" investment and development that have lower impacts on the environment and that create sustainable economic development, increased employment, and healthy communities; (3) exploring how settings with trees all along the urban-to-wildland gradient create values for people—whether neighborhood residents or recreation visitors—and how to practice more effective stewardship to enhance and sustain these values; (4) creating

a deeper understanding of how emerging technologies, products, and markets, along with changing economic and societal values, impact forests and the goods and ecological services they provide; and (5) inventing wood-based materials that create new markets or expand existing markets, including inventing advanced manufacturing and conversion processes for utilizing woody biomass and recycled materials. The prime objective for LRESR staff members across these five lines of inquiry is to build through synthesis and advocacy of field scientists' findings a solid scientific foundation for natural resource management and policymaking at multiple spatial scales in boreal, temperate, and tropical forest ecosystems.

The **Knowledge Management and Communications** (KMC) staff manages information flowing into, out from, and within the R&D mission area. The objectives are to: (1) build broader awareness of current research and potential future research areas; (2) develop messages for deliberate, focused outreach to clients inside and outside the agency; and (3) strategically improve awareness, appreciation, and use of scientific knowledge in forming opinions and making management and policy decisions. The KMC staff also defines, develops, and maintains the national information architecture and content of databases essential to managing the strategic information flow and messaging about R&D.

The **Policy Analysis** staff provides the Forest Service Chief and staff with timely, objective, and high-quality analyses of agency policies, programs, and practices.

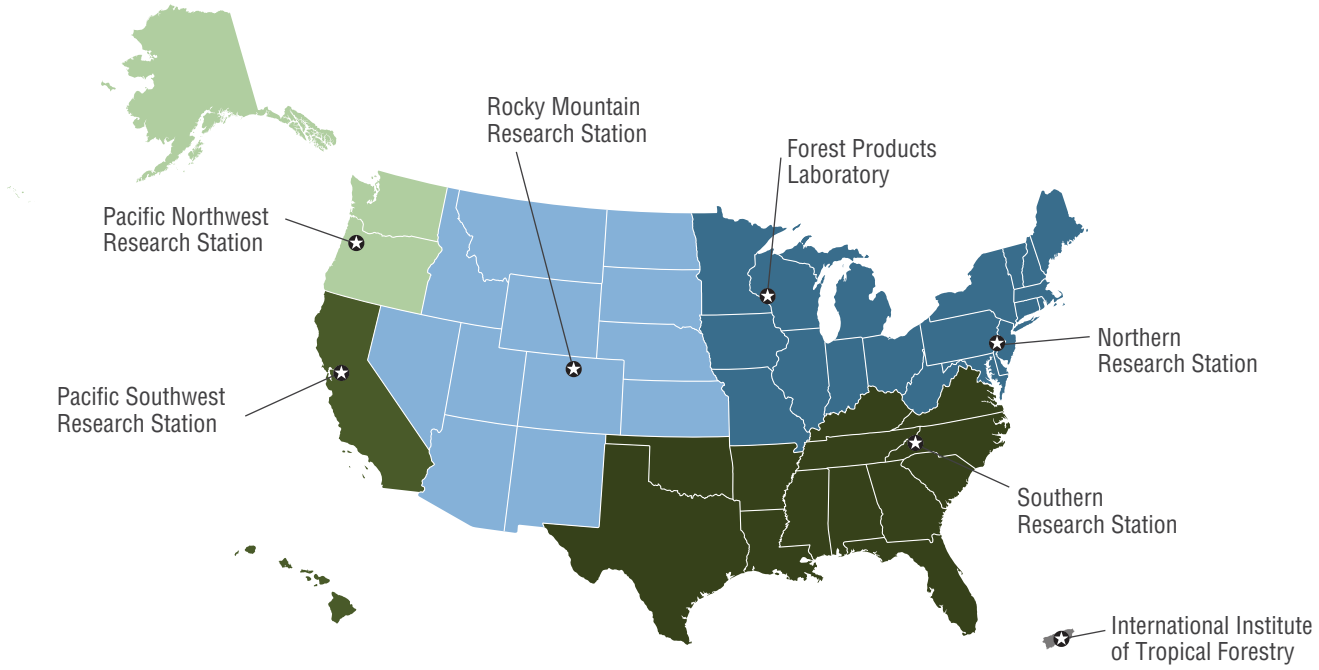
RESEARCH LOCATIONS

Forest Service R&D is a world leader in innovative science for sustaining global forest resources for future generations. Research findings and products benefit forest and rangeland managers and everyone who uses goods or services from forests. Forest Service R&D operates five research stations that encompass all 50 States; the FPL in Madison, WI; and the IITF in Puerto Rico. Approximately 500 scientists and hundreds of technical and support personnel work at 67 field sites throughout the United States, Puerto Rico, and the U.S.-affiliated Trust Territories and nations of the Pacific. Forest Service R&D maintains 81 experimental forests and rangelands, which support most of the agency's long-term research, across the Nation.

The **Forest Products Laboratory,** headquartered in Madison, WI, is concerned with the long-term health of the Nation's forests and how the Nation depends on sound conservation practices, including wood and wood byproduct utilization. FPL uses science and technology to conserve and extend the Nation's forest resources and to develop innovative wood-related products. FPL's mission is to promote healthy forests and forest-based economics through the efficient, sustainable use of wood resources.

The **International Institute of Tropical Forestry,** headquartered in Piedras, PR, has one work unit. The mission of this unit is to generate and disseminate scientific information in support of the sustainable use of tropical forests. The IITF accomplishes its mission through the development and dissemination of information on the use of forest resources, conservation of primary and secondary forests, rehabilitation of degraded lands, and management of wildlife and watersheds. This work is conducted through an extensive network of collaborators at home and abroad.

Forest Service Research Stations



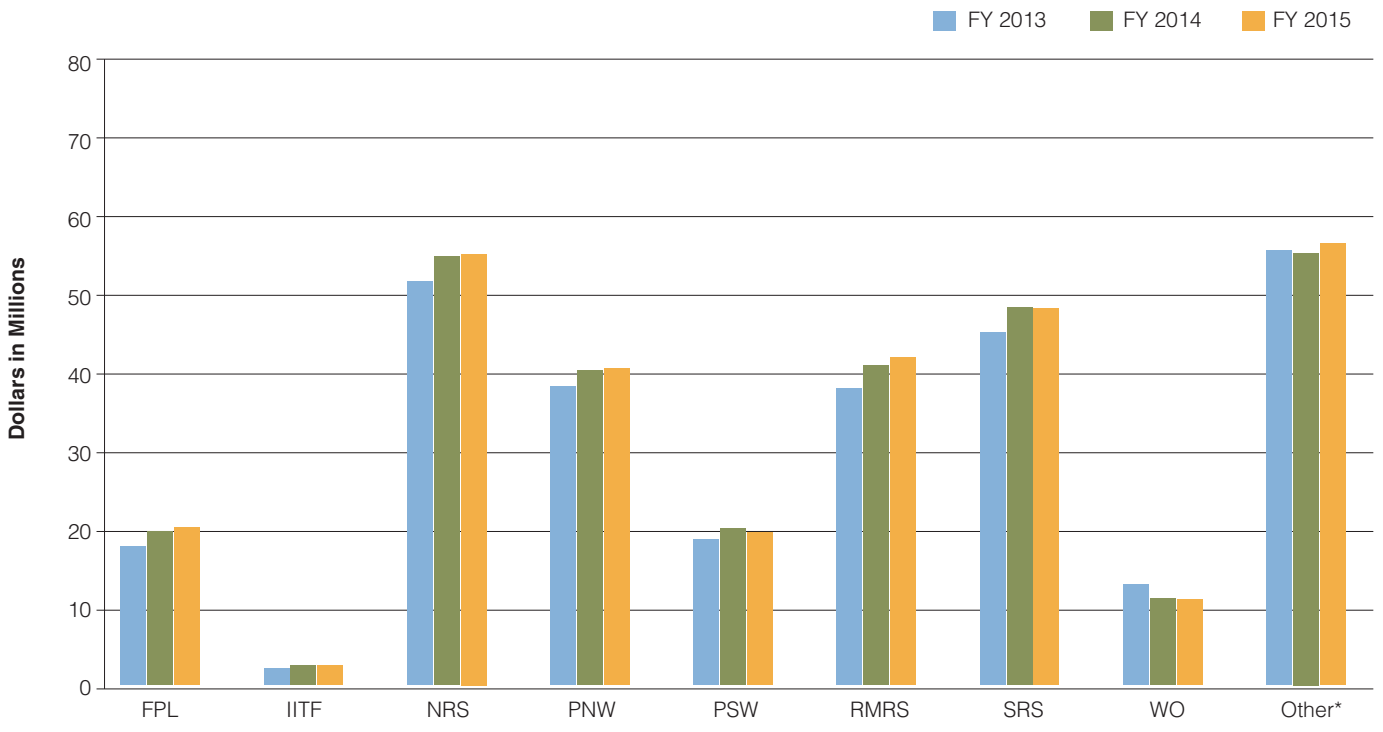
The **Northern Research Station (NRS),** headquartered in Newtown Square, PA, has research and development programs across 20 States in the Midwest and Northeast (Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin). The station's research products and technologies provide the knowledge and tools to protect people and forest landscapes from the threat of undesirable disturbances, improve the quality of life in urban areas through natural resources stewardship, maintain and enhance forest productivity and benefits, and increase the production of clean water and air for a growing human population.

The **Pacific Northwest Research Station (PNW),** headquartered in Portland, OR, maintains research and development programs in three States (Alaska, Oregon, and Washington) and provides scientific information to land managers, policymakers, and citizens. Like the other stations, its mission is to generate and communicate scientific knowledge that helps people understand and make informed choices about human behaviors and attitudes, natural resources, and the environment.

The **Pacific Southwest Research Station (PSW),** headquartered in Albany, CA, conducts research, development, and application programs in California, Hawaii, and the U.S.-affiliated Trust Territories and nations of the Pacific. The PSW's primary work occurs in California (the most populous State, with the eighth largest economy in the world) and Hawaii (a strategic location in the Pacific Rim economies and tourism industry). The station develops and delivers science-based information, technologies, understanding, and applications to help people make well-informed decisions about natural resource management, conservation, and environmental protection.

The **Southern Research Station (SRS),** headquartered in Asheville, NC, conducts research programs across 13 States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia). The SRS mission is to create the science and technology needed to sustain

Funding to Research Stations and Washington Office, FY 2013–2015



FPL = Forest Products Laboratory. IITF = International Institute of Tropical Forestry. NRS = Northern Research Station. PNW = Pacific Northwest Research Station. PSW = Pacific Southwest Research Station. RMRS = Rocky Mountain Research Station. SRS = Southern Research Station. WO = Washington Office.

*Includes the R&D contribution of the Agency's Operating Expenses.

and enhance southern forest ecosystems and the benefits they provide to the public. The SRS has 15 work units grouped under 5 science areas that clearly define core strengths: (1) threats to forest health; (2) forest ecosystem restoration and management; (3) forest values, uses, and policies; (4) forest watershed science; and (5) forest inventory and monitoring.

The **Rocky Mountain Research Station (RMRS),** headquartered in Fort Collins, CO, conducts research across 12 States in the Interior West (Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, and Wyoming). Research at the RMRS is organized into seven science programs and a science application program that oversees two Research, Development, and Application units. The RMRS employs more than 400 professional, technical, and administrative personnel and 95 research scientists. These scientists and professionals, in collaboration with a variety of Federal, State, and university partners, develop high-quality scientific information responsive to land management and natural resource policy issues related to water supply, fire suppression and use, invasive species, wildlife and fish, climate change impacts, forest products use, human relationships to the land, and forest and grassland ecosystem restoration.

FOREST SERVICE R&D WORKFORCE

In fiscal year (FY) 2015, Forest Service R&D had 1,848 full-time employees, or FTEs, including research scientists, biological and forestry technicians, statisticians, and administrative and technical support staff. During the past 5 years, the number of research scientists in Forest Service R&D was fairly stable—about 500 scientists. The number of R&D scientists, however, has declined 19 percent during the past 10 years. Hiring programs, such as the Scientist Recruitment Initiative, have been successful in attracting entry-level scientists to Forest Service R&D who will be positioned to research the current environmental and social issues facing the Nation's forests and grasslands. After completing their doctoral degrees, the students in the program will fill permanent scientist positions identified by program, research, workforce, and diversity needs.

Research Scientists, Fiscal Years 2011–2015

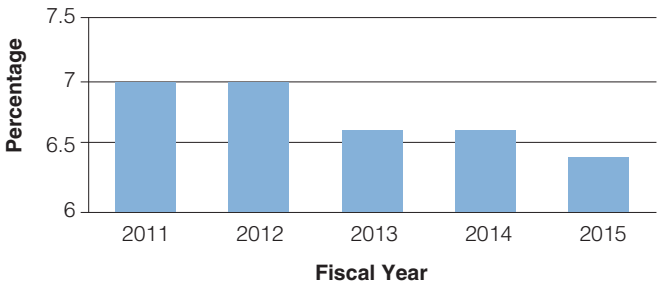
	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
R&D FTEs	2,138	2,052	1,933	1,861	1,848
Research scientists	537	515	500	500	500

FTEs = full-time employees. FY = fiscal year. R&D = Research and Development.

BUDGET AND FINANCE

Forest Service R&D focuses its resources on the agency's mission, the priorities identified in the current agency strategic plan, direction from Congress, and priorities from the Executive Branch. The base Forest Service R&D mission area is formulated using input from the research stations, including FPL and IITF, which prioritize efforts needed to address the nature and magnitude of current and anticipated future resource problems and information requirements of resource managers. Station directors communicate frequently with users of research products and technologies to ensure they consider local, State, and regional resource issues. The directors then request budget levels that best serve the science and technology needs of their clients, including other Forest Service deputy areas. These field requests are reviewed, coordinated with strategic priorities, and merged into a national research program. Funds are allocated to support the priorities and needs aggregated into the seven Strategic Program Areas (SPAs). Forest Service R&D places a high priority on accountability and is committed to making the best use of taxpayers' dollars. Financial accounting is consolidated at the agency level.

Research and Development Appropriation as Percentage of Forest Service Appropriation



In FY 2015, Forest Service R&D was appropriated $296 million, a 1.1-percent increase from FY 2014. This amount includes $70 million for FIA and $3.3 million from the facility maintenance fund. In addition, Forest Service R&D received $20 million for the National Fire Plan and $6.9 million for the Joint Fire Science Program. The total funding to R&D represents 6.4 percent of the FY 2015 Forest Service appropriation.

Summary of Budget Changes for Fiscal Years 2011–2015 (dollars in millions)

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Forest Service Appropriation*	**5,096,746**	**4,844,922**	**4,556,649**	**4,896,611**	**5,073,246**
Research Appropriation	235,837	227,418	214,830	222,040	222,040
Facility Maintenance Fund	3,995	3,613	4,117	3,960	3,960
Forest Inventory & Analysis (FIA)	66,805	64,269	60,907	66,805	70,000
Subtotal, Research (fund FRFR/ program FRRE)	**306,637**	**295,300**	**279,854**	**292,805**	**296,000**
National Fire Plan (FRFR/FRF2)	23,869	21,699	20,603	19,795	19,795
Subtotal, National Fire Plan (fund FRFR/ program FRF2)	**23,869**	**21,699**	**20,603**	**19,795**	**19,795**
Other Funding Sources: FIA					
State & Private Forest (Forest Health Protection)	0	0	0	0	0
Forest Resource Information and Analysis (SPIA)	5,025	4,917	4,660	0	0
National Forest System	0	0	0	0	0
Total FIA	**71,830**	**69,186**	**65,567**	**66,805**	**70,000**
Joint Fire Science Program (FRJF)	7,984	7,250	6,884	6,914	6,914
Facilities & Deferred Maintenance (CMFC and CMII)	13,566	4,500	3,751	4,309	3,283
Total, Research	**357,081**	**333,666**	**315,752**	**323,823**	**325,992**
Percent of Research Dollars From Forest Service Appropriation	**7.0%**	**6.9%**	**6.9%**	**6.6%**	**6.4%**
Forest Service Research Grants & Agreements (Extramural)	53,301	41,978	38,154	42,618	42,618
Percent of FRFR (= FRRE + FRF2 + FRJF) Budget in Grants & Agreements	15.7%	12.9%	12.4%	13.3%	13.2%
Number of Research Grants & Agreements	730	649	581	746	577
Research FTEs	**2,138**	**2,052**	**1,933**	**1,861**	**1,917**

*Discretionary Appropriation. Also includes any supplemental and emergency funding.
FIA = Forest Inventory and Analysis. FY = fiscal year.
FRRE, FRFR, FRF2, FRJF, SPIA, CMFC, CMII, and SPIA are Forest Service accounting codes.

THE FOUNDATION OF FOREST SERVICE R&D

Long-term research is the foundation of Forest Service R&D. Two critical resources help to make this longstanding research possible: (1) a vast network of experimental forests and rangelands and (2) the FIA program, a national annual census of the Nation's forests.

Experimental Forests and Rangelands

The Experimental Forests and Rangelands program provides the venue for long-term research in which Forest Service R&D scientists can address regional- to continental-scale environmental change issues in rural and urban areas. The 81 experimental forests and rangelands comprise lands dedicated to research that have been authorized by Congress and designated by the Chiefs of the Forest Service during the past 100 years.

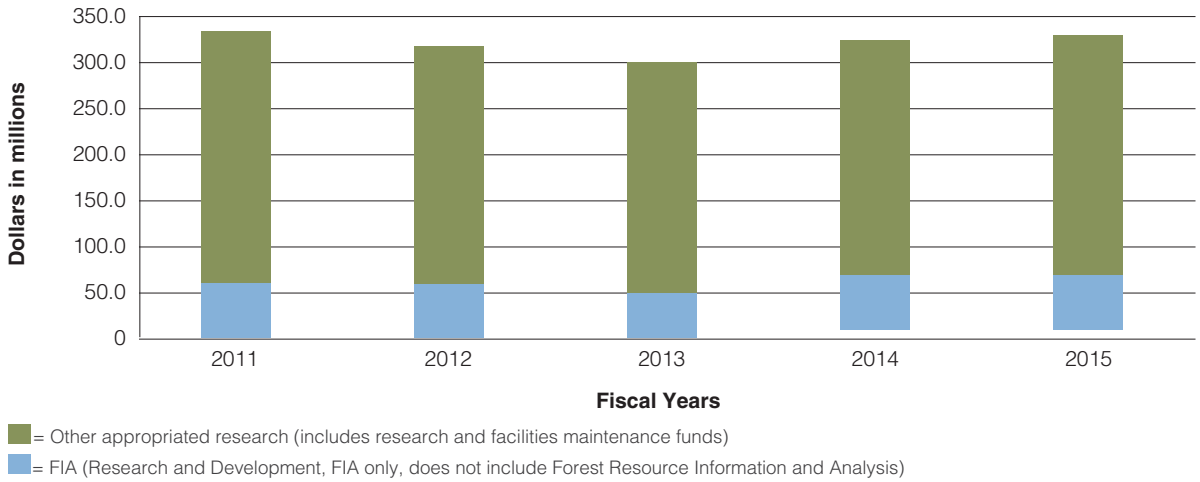
The Experimental Forests and Rangelands network, which has developed progressively since its inception in 1908, provides study sites for examining a wide variety of ecological questions that are specifically designed to address contemporary management challenges. Many of these sites are more than 50 years old and support research in all the major forest and rangeland vegetation types and geographical areas of the continental United States.

The experimental forests and rangelands are considered living laboratories, where Forest Service R&D can provide demonstrations of research project outcomes and results to cooperators and stakeholders. They represent some of the few places where ecological research can be maintained over the long term, and they perpetuate experimental studies far beyond the term of any individual scientist's career.

Forest Inventory and Analysis

The FIA program, a congressionally mandated census of the resources of U.S. forests, is conducted in partnership with the National Association of State Foresters and S&PF. The program, which operates out of NRS, PNW, RMRS, and SRS, is coordinated nationally from the WO. The FIA program assesses and reports on the status and trends in tree species by harvest, wood production and utilization, and forest land ownership. The FIA assessments extend to the Trust Territories and Puerto Rico and include reports on changes in carbon budgets and forest health. R&D manages the program in cooperation with a variety of partners, including State forestry agencies and private landowners, who grant access to their lands for data collection.

Forest Inventory and Analysis (FIA) Portion of Research Appropriations

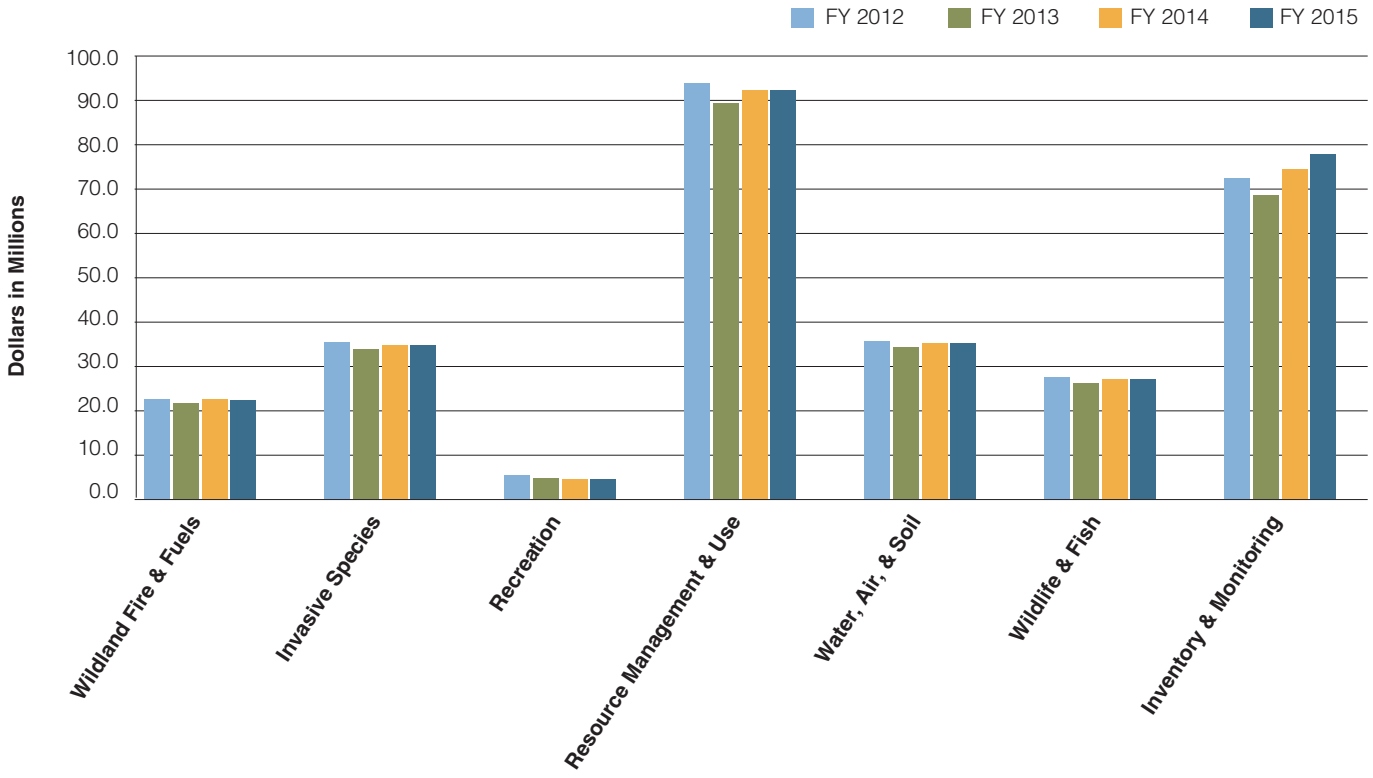


STRATEGIC PROGRAM AREAS

Forest Service R&D organizes research under seven SPAs, which support an integrated approach to the study of broad, complex environmental and social issues. SPAs provide consistent and stable nationally strategic subdivisions of the national Forest Service research program for program development; management of reviews and oversight; communication to national audiences, including national interest organizations, the Administration, Congress, and the general public; budget formulation and presentation; and the fostering of integration and collaboration among research stations and between stations and external partners.

The **Wildland Fire and Fuels SPA** provides the knowledge and tools that managers use to reduce negative effects and enhance beneficial effects of fire and of fire and fuels management on society and the environment. The SPA has five major focus areas: (1) the understanding and modeling of fundamental fire processes, (2) interactions of fire with ecosystems and the environment, (3) social and economic aspects of fire, (4) evaluation of integrated management strategies and disturbance interactions at multiple scales, and (5) application of fire research to address management problems.

Funding to Strategic Program Areas FY 2012–FY 2015



FY = fiscal year.

The **Invasive Species SPA** provides scientific information, methods, and technology to understand, reduce, minimize, or eliminate the introduction, establishment, spread, and effects of invasive species (and interactions with disturbance) and to restore ecosystems affected by invasive species or restore their function. The SPA focuses on plants, animals, fish, insects, diseases, invertebrates, and other species that are not native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm.

The **Outdoor Recreation SPA** provides human and ecological sustainability through research directed at understanding and managing outdoor environments, activities, and experiences that connect people with the natural world. Research in this SPA is interdisciplinary and focuses on nature-based recreation and changing trends in American society; connections among recreation visitors, communities, and the environment; human benefits and consequences of recreation and nature contact; the effectiveness of recreation management and decisionmaking; and the sustaining of ecosystems affected by recreation.

The **Resource Management and Use SPA** provides the scientific and technological base to sustainably manage and use forest and range resources and forest fiber-based products. Focus areas include plant sciences, soil sciences, social sciences, silviculture, genetics, productivity, forest and range ecology management, harvesting and operations, forest and biomass products and utilization, global change, economics, and urban forestry.

The **Water, Air, and Soil SPA** allows for the sustainable management of these essential resources by providing clean air and safe drinking water. The SPA features ecosystem services with a high level of integration among water, air, and soil research. It stresses the effects of climate variability and change on water budgets, and it focuses on carbon sequestration from an ecosystem perspective.

The **Wildlife and Fish SPA** relies on interdisciplinary research to inform policy initiatives and management strategies affecting wildlife and fish habitat on private and public lands and the recovery of threatened or endangered species. Scientists in this SPA investigate the complex interactions among species; ecosystem dynamics and processes; land use and management; and emerging broad-scale threats, including global changes in climate, loss of open space, invasive species, and disease.

The **Inventory and Monitoring SPA** provides the resource data, analysis, and tools needed to effectively identify the current status and trends of forests; management options and effects; and threats and effects of fire, invasive insects, disease, and other natural processes, enhancing use and value of the Nation's forests and grasslands. Assessing current and potential effects of changes in climate depends on monitoring forest ecosystems that are at the greatest risk from rapid changes in climate. Focus areas include the development and use of integrated interdisciplinary science, technologies, and remote sensing to increase the timeliness and spatial resolution of forest fragmentation caused by land use change; the describing of the incidence of invasive insects, disease, and fire; understanding forest carbon pools; and reducing the effects caused by extreme weather events.

PRIORITY RESEARCH AREAS

The Priority Research Areas (PRAs) of Forest Service R&D reflect the social, economic, and environmental forces discussed previously. The PRAs rest on a science foundation structured around R&D's SPAs that reflect the scope of Forest Service research capabilities. The PRAs set research priorities for the next 3 to 5 years.

1. **Forest Disturbance**—Research to improve the resiliency of forests, rangelands, and aquatic areas and to mitigate the adverse effects of climate change, including wildfire. This research includes studies addressing the effects and effectiveness of hazardous fuels treatments and biomass use.

2. **Forest Inventory and Analysis**—Research to make and keep current a comprehensive inventory and prospective future of the Nation's forest resources. The program surveys landowner objectives and values, partners with State forestry agencies to maintain field-based inventory of all ownerships, and conducts woodflow surveys of all primary wood-using facilities in the United States.

3. **Watershed Management and Restoration**—Research to promote the best management practices designed to protect and restore watersheds that enhance water quantity and quality.

4. **Bioenergy and Biobased Products**—Research to advance alternative energy sources and new markets that contribute to energy security and independence while reducing greenhouse gases.

5. **Urban Natural Resources Stewardship**—Research to improve the management, protection, and stewardship of urban natural resources to improve people's lives.

6. **Nanotechnology**—Research and technology to provide leading-edge innovations in the development of wood products.

7. **Localized Needs**—Research targeted to the geographic regions served by Forest Service research stations and field laboratories.

These seven PRAs demonstrate Forest Service R&D's commitment to remaining an interactive, vibrant, and visionary partner in solving today's critical problems with science and technology. This science and leadership service is a highly important investment for a world struggling with environmental change.

FOREST SERVICE STRATEGIC PLAN

The *USDA Forest Service Plan: FY 2015–2020* provides the strategic direction that guides the agency in delivering its mission and identifies major current issues important to natural resource management. The direction and issues are addressed in these goals.

STRATEGIC GOAL:
Sustain Our Nation's Forests and Grasslands

Strategic Objective A.
Foster resilient, adaptive ecosystems to mitigate climate change

Strategic Objective B.
Mitigate wildfire risk

Strategic Objective C.
Conserve open space

STRATEGIC GOAL:
Deliver Benefits to the Public

Strategic Objective D.
Provide abundant clean water

Strategic Objective E.
Strengthen communities

Strategic Objective F.
Connect people to the outdoors

STRATEGIC GOAL:
Apply Knowledge Globally

Strategic Objective G.
Advance knowledge

Strategic Objective H.
Transfer technology and applications

Strategic Objective I.
Exchange natural resource expertise

MANAGEMENT GOAL:
Excel as a High-Performing Agency

Management Objective A.
Recruit a diverse workforce

Management Objective B.
Promote an inclusive culture

Management Objective C.
Attract and retain top employees

The following are the total investments for all SPAs included in the Forest Service Strategic goals above.

Strategic Program Areas	Total Resource Investment for Strategic Goals
Wildland Fire and Fuels	20,383
Invasive Species	28,892
Outdoor Recreation	3,591
Resource Management and Use	100,096
Water, Air, and Soil	34,865
Wildlife and Fish	27,310
Inventory and Monitoring	9,395
Forest Inventory and Analysis	70,468
Total Goals	**$296,000**

RESOURCE INVESTMENTS AND SELECTED ACCOMPLISHMENTS PER AGENCY STRATEGIC GOALS

Strategic Goal:

Sustain Our Nation's Forests and Grasslands

The national forests and grasslands were established to protect the land, secure favorable water flows, and provide a sustainable supply of goods and services to the American people. The Forest Service provides land management assistance to the States, private forest landowners, and the NFS.

Resource Investments (dollars in thousands) per Strategic Program Area (SPA)

SPAs	FY 2015 ($)
Wildland Fire and Fuels	11,417
Invasive Species	16,659
Outdoor Recreation	1,796
Resource Management and Use	45,190
Water, Air, and Soil	18,058
Wildlife and Fish	16,352
Inventory and Monitoring	2,168
Forest Inventory and Analysis	15,962
Total Goal	**$127,603**

FY = fiscal year.

Selected Research Accomplishments per Goal Objective

Strategic Objective A:

Foster resilient, adaptive ecosystems to mitigate climate change

A science-based framework for restoring resiliency to frequent-fire forests. Forest Service R&D and university scientists and managers synthesized 100 years of published forestry science to help forest managers better understand the ecology of "frequent-fire" forests. This forest type, found throughout the Western United States, historically experienced frequent but low-severity surface fire events. The report provides a science-based framework that will assist land managers in developing management plans and

Thicket of trees in a ponderosa pine forest located on the Long Valley Experimental Forest depicts unhealthy forest conditions.

Photo courtesy of Richard T. Reynolds, Forest Service.

practices to restore an uneven-aged forest structure with tree groups and grass-forb-shrub interspaces between the groups that characterized these forests before the introduction of intensive management in the 19th and 20th century. Returning frequent-fire forests to their historical species composition and structure will increase their resilience to fire, insects, disease, and climate change. This new framework provides information to improve the resistance and resilience of these southwestern forests to severe disturbances by restoring the species composition, structure, and spatial pattern of their vegetation. The framework recreates groups of fire-adapted tree species with interlocking crowns; grass-forb-shrub openings between tree groups; scattered individual trees within the grass-forb-shrub matrix; and snags, logs, and woody debris. Restoring these elements facilitates the return of the types and frequencies of disturbances that these forests evolved with, thereby lowering the probability of catastrophic loss and better positioning them to adapt to climate change.

Strategic Objective B:
Mitigate wildfire risk

A new approach and planning framework for coupling biophysical and social dimensions of wildfire risk mitigation. Scientists developed this approach to address gaps in local planning and broad-scale prioritization of Federal and State assistance to mitigate wildfire risk on Federal lands near high-risk communities. Their work explicitly incorporates social science information pertaining to mitigation potential among private landowners and information on risk transmission to identify the sources of wildfire exposure to communities. The results from the pilot studies will influence funding allocation that targets specific communities for risk-reduction activities and will lead to improvements in the community wildfire protection planning process as case studies are implemented. The outputs from this study are being distributed and implemented through a new interactive geospatial Web portal that will allow communities to interact with social and biophysical assessment data and strategize on potential mitigation activities. This work has become a key component of the "all lands" wildfire risk management strategy currently being promoted. The methods and concepts are also being used to improve wildfire risk assessment methods in the Forest Service to better inform funding allocation for wildfire protection in the wildland-urban interface (WUI).

Wildfire has no regard for property boundaries.

Photo courtesy of Paige Fischer, Forest Service.

Strategic Objective C:
Conserve open space

Valuing wildfire impacts of recreation demand. This study investigates the recreation values of the San Jacinto Wilderness in southern California. The analysis utilizes survey data involving backcountry visitors who responded to questions about recreational trips. Benefits of landscape preservation are derived using an economic model. The model results suggest that the recreation values can be substantial for some of the hiking trails. For complete trail closure due to high-intensity wildfires, the estimated total seasonal wilderness recreation loss for the San Jacinto Wilderness is $3.7 million. The results can help fire managers to plan more efficient fire-management strategies and reduce potential losses from wildfires and other catastrophic disturbances. This may reduce environmental and social costs and thus enhance conservation of the resource for present and future generations.

Devil's Slide Hiking Trail.

Photo courtesy of José J. Sánchez, Forest Service.

Strategic Goal:

Deliver Benefits to the Public

The public demand for high-quality outdoor recreational experiences places pressure on the ecological integrity of national forests and grasslands. The combination of increasing U.S. populations and declining public access to privately owned forest land creates demand for public lands to provide more recreational opportunities. If public lands are to provide additional recreational benefits without unacceptable resources effects, Forest Service R&D must emphasize effective management solutions that have a solid scientific foundation. Forest Service R&D studied the effects of changing demographics and people's perceptions of the value, importance, and opportunities created by healthy forests and rangelands. The research helped communities understand the relationship between the quality of the recreation experience and the importance of ecological integrity to maintain recreational opportunities into the future.

Resource Investments (dollars in thousands) per Strategic Program Area

SPAs	FY 2015 ($)
Wildland Fire and Fuels	2,111
Invasive Species	4,655
Outdoor Recreation	758
Resource Management and Use	18,624
Water, Air, and Soil	5,345
Wildlife and Fish	2,615
Inventory and Monitoring	2,088
Forest Inventory and Analysis	17,901
Total Goal	**54,097**

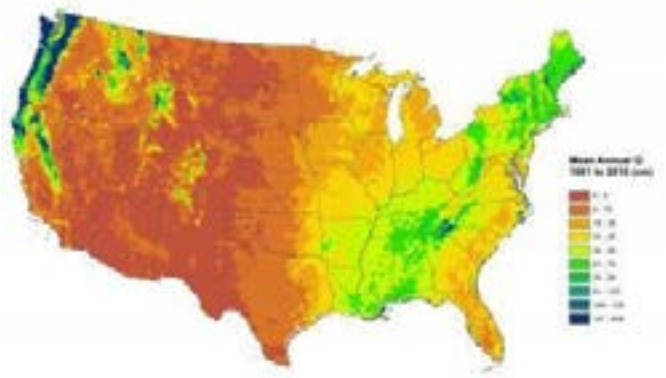
FY = fiscal year.

Selected Research Accomplishments per Goal Objective

Strategic Objective D:

Provide abundant clean water

Water supply of the contiguous United States. This study estimated water supply across the contiguous 48 States for the period 1981–2010. Political, administrative, and land-cover boundaries were mapped over the gridded water supply estimates to indicate the amount of water available in respective land areas. Forests occupy 26 percent of the land area of the contiguous United States but yield 46 percent of the mean annual water supply. Rangelands occupy 37 percent of the land but yield only 14 percent of the water supply, largely due to higher temperatures and lower rainfall that typify much of this land cover type. In the West, the highest yields are concentrated in the mountainous areas of the north Pacific Coast, the Sierras of California, and the northern and central Rocky Mountains. Away from these mountainous areas, mean annual yields in the West tend to be ≤15 cm/yr. Yields are uniformly ≤15 cm/yr in the Great Plains and Southwest. Yields east of the Great Plains tend to exceed 30 cm/yr except for areas along the eastern edge of the Great Plains, some areas near the Great Lakes, and areas along the south Atlantic coast including Florida. The amount of land managed and the elevation and rainfall that occur on those lands explain the significant differences in the water yielded from lands administered by the Forest Service and those administered by the U.S. Department of the Interior, Bureau of Land Management (BLM). Forest Service lands yield 18 percent of the water supply from 11 percent of the land area, and BLM lands yield 2 percent of the water supply from 9 percent of the land area.



Map of the mean annual water supply for the contiguous 48 States.

Forest Service map.

Strategic Objective E:
Strengthen communities

Green patterns for vacant lots in Baltimore. The solution for Baltimore's chronic urban blight—14,000 vacant lots and 16,000 abandoned structures—includes a vision for a citywide program to transform many blighted areas into an integrated network of green spaces. Transforming the vacant land into parks, forests, or gardens could help grow the city to be resilient, sustainable, and competitive in the 21st century. The Green Pattern Book is a tool that provides eight potential patterns by which city agencies, nongovernmental organizations, community-based organizations, and individual residents can green vacant lots and partner with each other to achieve more livable Baltimore neighborhoods. Created by the Baltimore Office of Sustainability in partnership with the NRS, the book includes patterns ranging from urban agriculture, to forest, to stormwater management. The Green Registry is a publicly accessible, online interactive mapping tool that allows users to register and map their own greening activities. Created in partnership with the Baltimore Neighborhood Indicators Alliance, this tool will inform policymaking and individual greening efforts and enhance the connectivity of Baltimore's environmental stewardship network. These two efforts are essential components of Forest Service leadership in Baltimore's Urban Waters Program: (1) Green Pattern Book, (2) Local Projects, (3) Monitoring and Modeling, and (4) Mapping.

Sunflower Garden

Photo courtesy of Mark Cameron, Baltimore City Department of Public Works, MD.

Strategic Objective F:
Connect people to the outdoors

Tree-planting programs a gateway to strong civic engagement. Once considered the antithesis of a verdant ecosystem, cities are being hailed as efficient social ecological systems. Emerging from the streets of the post-industrial city are well-tended community gardens, reforestation areas, and other viable habitats capable of supporting native flora and fauna. At the forefront of this transformation are the residents themselves. Research by a NRS scientist and collaborators resulted in *Urban Environmental Stewardship and Civic Engagement: How Planting Trees Strengthens the Roots of Democracy,* a book discussing how people engage in stewardship and what civic participation in the environment means for democracy. Researchers interviewed MillionTreesNYC volunteers and found that that the simple act of planting a tree at a volunteer event was so transformative for first-time tree planters that it led them to become more civically involved in their community. As governments are investing in green infrastructure campaigns to change the urban landscape, this book sheds light on the social importance of these initiatives and shows how individuals' efforts to reshape their cities serve to strengthen democracy.

MillionTreesNYC volunteers in action, City of New York/NYC Parks, NY.

Photo courtesy of Malcolm Pinckney, NYC Parks.

Strategic Goal:

Apply Knowledge Globally

Forest Service R&D provides science and technology solutions for clients' and partners' priority issues in ways they find effective and useful for sustainably managing forests and grasslands.

Resource Investments (dollars in thousands) per Strategic Program Area

SPAs	FY 2015 ($)
Wildland Fire and Fuels	6,855
Invasive Species	8,577
Outdoor Recreation	1,038
Resource Management and Use	36,282
Water, Air, and Soil	11,462
Wildlife and Fish	8,343
Inventory and Monitoring	5,139
Forest Inventory and Analysis	36,606
Total Goal	**$114,300**

FY = fiscal year.

Selected Research Accomplishments per Goal Objective

Strategic Objective G:
Advance knowledge

"Smart Forests" digital environmental sensors and telecommunications take research to new levels. The Forest Service's experimental forests and rangelands provide critical data on environmental change in natural and managed ecosystems throughout the United States. A new generation of environmental sensors is accelerating our ability to rapidly collect and transmit these types of data to stakeholders in real time. The Forest Service is investing in this technology to create "Smart Forests"—an integrated research and monitoring program that will be invaluable for rapidly assessing the Nation's air, water, and forest and rangeland resources in the 21st century. Smart Forest technology has been deployed by NRS scientists at 10 sites in the Northeast, with more coming online in 2016. Key components of the Smart Forest Network include: (1) a common suite of sensors for biological, physical, and chemical measurements; (2) real-time data delivery to a single Web access point; and (3) interactive data visualizations and content for scientists, educators, and the public. Scientific breakthroughs and natural resource stewardship will be increasingly powered by tools that help researchers manipulate massive datasets,

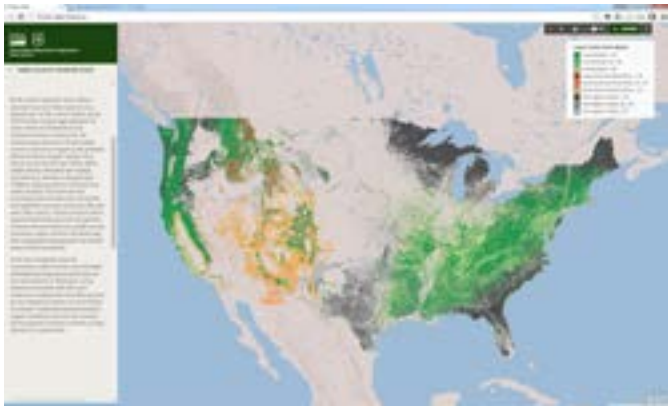
Phenocam and antenna on top of the Pierce Laboratory at the Hubbard Brook Experimental Forest, NH.

Photo courtesy of Lindsey Rustad, Forest Service.

visualize that data, and offer new ways to understand and manage ecosystem change. The Smart Forests program is helping make this technology available to experimental forests and rangelands sites across the Nation.

Strategic Objective H:
Transfer technology and applications

Forest Inventory and Analysis has new solutions for distributing research data. Technology is changing the way the public receives and uses information. Mapping applications have become ubiquitous, and there is demand for spatial data that can be viewed and analyzed to suit individual needs. Along with these changes, the U.S. Government has established an open data policy and launched geoplatform.gov and data.gov to improve public access to Federal data. The FIA program has traditionally produced printed maps, reports, and research articles, and provided downloadable pdf (Portable Document Format) and electronic data files. Recently, a team of FIA staff scientists began to deliver information in new digital formats. Several FIA-produced geospatial datasets, including Brewer's 1873 historical woodlands map, forest ownership, and forest carbon stocks, are hosted by the Forest Service's Enterprise Data Warehouse and Raster Data Warehouse. These services allow the public to view and interact with data in a Web browser. Data can also be combined with other geospatial data in a familiar map interface or used in specialized Geographic Information Systems (GIS) software. Data can also be accessed using the Esri ArcGIS Online portal. In addition, these datasets, along with the FIA database, have dedicated pages on geoplatform.gov and data.gov, which deliver authoritative Federal data to the public.



Web-based map browser viewing forest carbon stock data produced by the Forest Inventory and Analysis program.

Photo courtesy of Charles Perry, Forest Service.

Strategic Objective I:
Exchange natural resource expertise

Maps locate the wildland-urban interface (WUI) across the United States. WUI areas—where houses and other development meet or mix with undeveloped natural areas—are places of transition, change, and great fire danger. Wildland fires have recently been in the news for burning down rural towns, second homes, and businesses in many States, especially in the drought-stricken West. The fires create smoke that endangers wildlife and causes visibility and health problems for people living miles away. New development and roads in the WUI also introduce or spread invasive plants and animals to natural areas. Knowledge of WUI locations is extremely useful for policymakers, land managers, fire managers, and others. After studying the WUI in the United States for more than 10 years, NRS scientists developed and refined a scientifically based definition of the WUI and created maps that show past, present, and projected future WUI locations. A new user-friendly atlas and related data files provide valuable information for anyone who wants to learn about WUI locations at the local, State, or national scale. The atlas has recently attracted media attention from local, national, and international outlets including *USA Today, Science Daily,* and public radio.

Management Goal:

Excel as a High-Performing Agency

Forest Service R&D success depends on a high-quality, diverse workforce. Forest Service R&D continues to demonstrate commitment to improving diversity and inclusiveness by recruiting a diverse workforce, promoting an inclusive culture, and attracting and retaining highly qualified and skilled employees to ensure the mission is accomplished.

Selected Research Accomplishments per Goal Objective

Management Objective A:
Recruit a diverse workforce

Forest Service R&D worked with diverse academic cooperators and others to provide targeting outreach opportunities, including providing student development by partnering with institutions that support higher education and internships.

- **Forest Service R&D Exemplifies Success in Recruiting Women Scientists.** Diverse scientific communities foster innovation and problem solving more effectively than communities with a narrow range of knowledge, skills, and experience. However, gender diversity among scientists is limited, particularly in natural resource fields. Scientists in the NRS worked with university cooperators to compare data on scientist gender and rank from Forest Service R&D to data on faculty gender and tenure status from universities with comparable areas of study. Findings show that representation of women is greater among Forest Service R&D scientists than in university faculties, particularly among recent hires. Researchers attributed this finding to the earlier onset of diversification initiatives in Forest Service R&D, as well as differences in organizational structure between the two institutions wherein hiring processes are more centralized in hierarchical government institutions than loosely coupled university systems. This work suggests that additional attention to the role of institutions in defining workplace culture may facilitate diversification.

- **Mentoring Native American youth in "WaYS" Internship Program.** The Wabanaki, or Native American peoples of Maine, are engaged in natural resource management on tribal lands and are important stakeholders in public land management as it relates to cultural values and traditional uses. Despite this involvement, few Native American students pursue or persist in natural resource-oriented majors and careers. To support Native American youth interested in the great outdoors, the NRS and Penobscot Nation are collaborating with the University of

Female research scientist at work. Dr. Christel Kern, research forester, hosting a professional tour of the Argonne Experimental Forest for forestry staff from the Chequamegon-Nicolet National Forest.

Forest Service photo.

WaYS Forward interns inventorying understory plants in a Forest Service research area on the Penobscot Experimental Forest in Maine.

Photo courtesy of Tish Carr, University of Maine.

Maine and others to provide internships for high school and college students. This program, called "WaYS Forward," employed five students in 2015 to conduct ecological inventory at a long-term Forest Service research site at the Penobscot Experimental Forest. Students are now summarizing their findings and will return next year to undertake nonnative plant removal and construction of an interpretive trail. Throughout the program, students are mentored by scientists and cultural-knowledge keepers, thus integrating western science and traditional ecological knowledge. Funding is provided by the Forest Service, the National Fish and Wildlife Foundation, and a Wells Fargo Environmental Solutions grant.

Management Objective B:
Promote an inclusive culture

Forest Service R&D convened a WO "All Employees" meeting to develop best practices around specific employee concerns. The result was improved clarity around the employees' concerns and action plans designed to improve communications, internal and external networking, and telework management.

Management Objective C:
Attract and retain highly qualified and skilled employees

In February 2015, the WO recognized four scientists at the R&D Deputy Chief's Awards Ceremony for their outstanding contributions to research and science delivery. The Early Career Scientist was also nominated for the Presidential Early Career Awards for Scientists and Engineers.

Additionally, WO R&D:

- Promoted employee development (in collaboration with stations) through the use of R&D Scientists Initiative and early career scientist mentorship and training.
- Created an effective on-boarding process to retain new hires.
- Provided detail opportunities for staff to gain additional skill sets and competencies.
- Engaged employees in leadership-development programs and other opportunities, such as one-on-one mentorship with senior executives.

Reliable information, good-quality facilities, and land protection are necessary to effectively manage natural resources in a perpetual state of change. Forest Service R&D must maintain investments in research laboratories, experimental forests and rangelands, information systems, and a skilled workforce to support the research necessary to inform natural resource management decisions and activities.

R&D Capital Investment and Improvement Project by Research Station Resource Investments (dollars in thousands)

Region/Station/Area	State	Project Name and Type	Funding ($1,000s)
PSW	Hawaii	Hawaii Experimental Tropical Forest Infrastructure Construction, Phase 7	1,000
FPL	Wisconsin	Building 33 Fume Replacement	603
FPL	Wisconsin	Buildings 29 & 34 Fume Hood Replacement	802
NRS	West Virginia	Morgantown Forestry Sciences Lab HVAC Replacement Phase	320
NRS	Ohio	Delaware Forestry Sciences Lab Greenhouse Replacement	275
SRS	Texas	Nacogdoches Wildlife and Silviculture Lab HVAC Replacement	283
Total:			**$3,283**

FPL = Forest Products Laboratory. NRS = Northern Research Station. PSW = Pacific Southwest Research Station. R&D = Research and Development. SRS = Southern Research Station.

For more information on the research accomplishments presented here, please visit http://www.fs.fed.us/research/highlights/. You may also scan this Quick Response Code with your smartphone to access the accomplishments (Highlights).

COLLABORATION

Forest Service R&D's enterprise consists of conducting high-quality scientific research, applying findings to NFS lands, and making these findings available to others for application to their lands. Forest Service R&D distributes information and technology to land managers and land-use planners using a variety of mechanisms, including publications, videos, training, and demonstrations. Forest Service R&D's ability to interact with users of its research and transfer technology is substantially enhanced through partnerships, particularly those with other research organizations, land management practitioners, State agencies, urban planners, private forest owners, private organizations, and horticultural and agricultural interests.

These partners of Forest Service R&D include Federal and State agencies, universities, industry, nongovernmental organizations, tribal governments, and foreign government research cooperators.

The agency's international research engagement includes individual collaborative research projects between Forest Service scientists and their counterparts worldwide, as well as more formalized longer term research projects between Forest Service research teams and universities or government research organizations. It also involves networking activities between our scientists and international colleagues through regional associations, such as the North American Forestry Commission, and global networks, such as the International Union of Forest Research Organizations. The Forest Service has been actively involved as a member organization with the international union for nearly a century.

International research collaboration plays a vital role in accomplishing the Forest Service's mission by harnessing the knowledge and experience of forest and rangeland scientists worldwide to develop science-based solutions more efficiently. It also enhances the work of the agency's International Programs Office by providing technical and scientific expertise to projects and programs financed by the U.S. Agency for International Development that deal with forest-related issues related to biodiversity conservation, climate change mitigation and adaptation, and forest landscape restoration. Our work also provides necessary scientific and technical expertise to the State Department and other U.S. Government agencies in the development and effective implementation of regional programs and environmental agreements related to forests, such as the Conventions on Biological Diversity, the United Nations Framework Convention on Climate Change, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Forest Service R&D has a long history of supporting extramural research through grants and agreements (G&As) with colleges and universities; State, local, and tribal governments; nonprofit organizations; industry; and individuals. In FY 2015, 577 G&As were issued and made, which was 22.7 percent lower than in FY 2014. As in FY 2014, the total G&As accounted for 13 percent of the Forest Service R&D budget in 2015.

Number of Grants and Agreements and Percentages of Forest Service R&D Budget

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Number of G&As	732	649	581	746	577
Percent of R&D budget	16	13	12	13	13

FY = fiscal year. G&As = grants and agreements. R&D = Research and Development.

MEASURING FOREST SERVICE R&D PERFORMANCE

The Federal Government uses three key indicators to evaluate success in research and development: (1) relevance, (2) quality, and (3) performance.

Relevance—Measured by a Customer Satisfaction Survey

Since 2006, the Forest Service R&D has conducted a customer satisfaction survey every 3 years. This survey is of the various people and groups that use Forest Service R&D research information and products. FY 2015 was the fourth time the survey was conducted; the next scheduled survey will occur in FY 2018.

The 2015 customer satisfaction model included three main components: (1) relevant activities in each area that drive customer satisfaction, (2) satisfaction itself, and (3) desirable customer behaviors and outcomes. The FY 2015 survey scored 76, which represents a 3-point decline from the previous measure in 2012, but significantly better than the aggregate score of 67 for all other Federal agencies, and still above the baseline score of 72 from the initial survey in 2006. The survey also indicated that Forest Service R&D products have a high impact on satisfaction. Products are rated as being scientifically sound and sources of authority. Forest Service R&D staff, along with relevance and quality, continues to be the highest rated of all satisfaction driver areas. Forest Service R&D incorporated the results from this survey into program planning to ensure that the work R&D does is relevant to customers' needs

Quality—Measured Through R&D Quality Assurance Processes

Forest Service R&D places a high value on conducting sound science research that customers and the scientific community view as being of the highest quality. The R&D Deputy Area has been refining quality assurance processes so that only high-quality, accurate data are reported and has been increasing its transparency with the public by publishing accomplishment information on public Web sites. In addition, to ensure the quality of data reported, R&D has been employing stringent standards for ensuring scientific integrity. For example, Forest Service R&D invites panels of international and external reviewers to evaluate its performance. Such reviews include:

- Refereed reviews of publications
- Statistical reviews
- Quality assurance and quality control procedures
- Research grade evaluation processes
- Research performance accountability reviews

Performance—Measured Through Reporting

Forest Service R&D publishes annual performance and accountability reports, contributes to the USDA annual report on technology transfer, and reports on accomplishments in the annual Forest Service budget justification. In FY 2015, Forest Service R&D met or exceeded 88 percent of its targets. The one target that was not met underperformed by 4 percent.

The deputy area continued to list publications as formally refereed or informally refereed and reported other products and activities as science delivery products and services. These designations helped to emphasize the growing importance R&D places on delivering the science in addition to producing published science products.

Forest Service R&D continues to track citations of its publications and uses the citations to index the influence of scientists' work. Citations can be used for research policymaking, monitoring scientific developments, and grant

decisions. The basic assumption behind citation analysis is that influential research or scientists are cited more often than others. In this sense, citations reflect the relative effect and utility of scientific work, although the use of this index to attribute relative performance to an individual is controversial. During the previous 10 fiscal years ending in September 2015, Forest Service publications were cited in other formally peer-reviewed publications a total of 146,337 times, with an average of 14,364 citations a year. For that period, 596 R&D publications were cited 50 or more times and 1,945 R&D publications were cited 20 or more times.

Trends in Forest Service R&D Performance Outcomes

Performance Measure	FY 2013	FY 2014	FY 2015
Customer satisfaction	79	79	76
Patent applications filed (5-year rolling average)	7	10	12
New inventions disclosures received	25	19	24
Patents issued (5-year rolling average)	4	4	6
Patent licenses executed	2	2	2
New interagency agreements and contracts	44	47	183
Interagency agreements and contracts continued	2	15	78
International cooperative agreements executed	0	0	17
Invasive species tools developed, delivered, and used (5-year rolling average)	193	168	258
Formally refereed publications	3,014	2,090	1,151
Informally refereed publications	446	384	862
Number of refereed publications	—	2,083	2,013
Number of science delivery products	—	49	442
Number of science delivery activities	—	1,224	2,513
Dollars of research funds awarded to institutions of higher learning	—	$35,034,675	$28,368,210
Dollars of research funding awarded to HBCUs, TCUs, and HSIs	—	$950,615	$1,025,624
Funding awarded to nonacademic institutions	—	$15,667,381	$13,908,476
Total amount of G&As awarded to other organizations	—	$50,702,056	$42,276,686
Leveraged funds from G&As (funds and in-kind services)	—	$20,549,216	$20,933,070
Fire science quality efficiency index	3.5	4.5	5
Fire science quality science index	5	3.4	4
Percent of States for FIA data	13	98	98

FIA = Forest Inventory and Analysis. FY = fiscal year. G&As = grants and agreements. HBCUs = Historically Black Colleges and Universities. HSIs = Hispanic Service Institutions. R&D = Research and Development. TCUs = Tribal Colleges and Universities.
— denotes data were not collected for these years.

NATIONAL ACCOMPLISHMENTS

Most of the Forest Service R&D program is targeted to local and regional issues, executed by scientists at field locations and administered by research stations across the United States. Forest Service R&D also delivers products and services with a national scope, which are administered by WO staff members at the headquarters or by those embedded in the field. In FY 2015, these national programs reported the following significant results.

- **Real-Time Fire Mapping.** Forest Service scientists, together with universities and other agencies, developed methods to provide near-real-time fire mapping and measurement information based on satellite data. This data has been incorporated in a simulation model that includes weather forecasts to provide short-term predictions of fire spread and activity. These advances greatly enhance the ability of fire-fighting agencies to identify and respond to wildland fires quickly, as well as to plan for upcoming fire seasons.
- **Detecting White Nose Syndrome Fungus.** White Nose Syndrome (WNS) fungus has decimated North American bat populations in recent years. The impact of decreasing bat populations on agricultural crops is estimated at more than $3.7 billion per year, making control of the WNS fungus critical. To this end, Forest Service scientists created the most accurate and sensitive DNA technique for detecting the fungus in almost any kind of sample. This test set the new standard and is being used by a team from the Forest Service, U.S. Geological Survey, and the University of Wisconsin-Madison to survey soil samples from across the eastern North America. This test is 100-fold more sensitive than prior tests and facilitates detection of the fungus before the clinical disease is observed.
- **Accessible FIA Data.** Forest Service R&D implemented FIA annual forest sampling in all 50 States. More than 42,000 field plots were measured, representing 14 percent of the FIA national plot system. FIA data less than 2 years old are accessible at http://www.fia.fs.fed.us.
- **Urban Tree Analysis.** Forest Service scientists analyzed urban tree cover nationally, revealing a decline of about 20,000 acres or about 4 million trees per year. Understanding change and trends in urban forests helps cities and towns develop urban forest management plans and sustainability strategies that improve environmental health and community well-being into the future.
- **Cellulose Nanocrystal Pilot Plant.** In August 2012, the Forest Products Lab unveiled a production facility for renewable forest-based nanomaterials. This facility is the first of its kind in the United States and supports an emerging market for wood-derived renewable nanomaterials, helping spur forest-based job growth and contributing an estimated $42 billion to the American economy by 2020.
- **National Green Building Standard.** Forest Service R&D cooperated with the National Association of Home Builders to develop the National Green Building Standard. The standard promotes the use of green building materials and provides incentives for architects and builders to specify and use wood in nonresidential construction.
- **New Tool for Watershed Analysis.** Forest Service scientists partnered with the Earth Systems Institute to develop NetMap, a platform for rapidly conducting cost-effective watershed analysis. This tool supports climate-smart restoration and management by identifying areas of watershed that are likely to warm, are vulnerable to erosion and mass wasting from wildfires and floods, and are most productive for fish. NetMap is available in the Northwest and is being expanded to cover other western regions.
- **Detecting the Walnut Twig Beetle.** Forest Service scientists developed a highly effective lure for the walnut twig beetle, which spreads cankers disease in thousands of walnut trees. This beetle threatens international walnut cultures as well as timber production. The lure, a synthetic beetle pheromone, enables faster detection and mapping of this invasive insect.